Strong order book for AIXTRON 1995-96

In keeping with the generally excellent market growth in mainstream semiconductors the past year has been very good for a number of III-V equipment and material suppliers. Most important has been the optoelectronics sector where high brightness LEDs and lasers have done better than ever. However, in keeping with the current heightened interest in shorter wavelength materials and devices – especially the blue-emitters based on III-nitrides – MOVPE suppliers are enjoying record business. Early in the New Year, AIXTRON President, Holger Jürgensen, a veteran of the industry was very pleased to confirm this fact.

Q: I understand that last year was particularly good for AIXTRON?

A: Yes indeed, as we begin 1996 I am delighted to inform all customers and friends that last year was an excellent year, particularly in the III-nitride MOVPE technology.

In 1995 AIXTRON shipped more than ten III-nitride MOVPE reactors for both R&D and multiwafer manufacturing applications, and we have a further healthy order book for 1996 with an extended customer base which includes important LED manufacturing sites in Japan, Korea, Taiwan and California.

As you reported in *III-Vs Review*, by mid-95 we had already secured three major contracts for the AIX2000HT. Particularly satisfying was the AIX2400 Planetary Reactor system to Siemens for mass production of yellow-red ultra-high-brightness LEDs.

Q: What device types are particularly notable at the moment and what specifically does MOVPE have to offer?

A: Customers have been able to grow a wide variety of optoelectronic device structures targeted towards LED, laser and other optoelectronic and electronic applications.

Now red, green and blue high brightness LEDs are on the market, all made by MOCVD. This will generate a huge market for such a variety of new products that we cannot even yet imagine.

For the III-nitrides our MOVPE reactors include all the necessary steps of growth initiation, InGaN growth with a wide range in In content, *in situ* p-doping etc. which all require very flexible reactors with flow stability and high growth efficiency at all pressures. This is a clear advantage of the Planetary Reactor. It is important that we have developed a unique and very advantageous method for nitridation and growth initiation on the sapphire substrate. Using our specially developed indium supply system, precise control of the indium content has been achieved, producing highly uniform layers and reproducibility.

InGaN/GaN QW and MQW structurs have been studied and the growth of very abrupt interfaces on the monolayer scale is now possible due to the well proven horizontal two-flow reactor concept used in all AIXTRON reactors, whether for R&D or production. As you published earlier, one of our customers is already making blue LEDs.

Q: What kind of reactors are used in R&D?

A: For R&D applications we offer the AIX 200RF which has capacity for a single 2-in wafer, or the AIX 200/4 HT which has capacity for 2-in to 4-in wafers and these are presently the most popular reactors. These allow growth of excellent quality material as a precursor to switching up to mass production as and when required.

Processes can then be transferred to the large reactors because the two-flow horizontal reactor is already compatible. Our customers acknowledge that these are the most flexible and reliable tools for the job. The reactors are designed not only to fulfil customers' R&D requirements, but also for full-scale production of III-nitride-based materials.

Q: What about the AIX2000 that we reported on during last year?

A: The most recent breakthrough in mid-1995 came with the successful introduction of the blue LED manufacturing reactor AIX 2000/2400 HT. This is, we believe, the largest ever multiwafer reactor made for this application. Because of its unrivalled throughput it was immediately ordered by leading LED companies and during 1995 alone we secured no less than eight very important orders for this MOVPE Planetary Reactor for GaN/AlGaN on 7x2-in or 5x3-in wafers.

The reactors are designed for scaling up production to eight 3-in or five 4-in wafers at a time. In the field these multiwafer production reactors are ramping up capacity for LEDs like never before.

Q: What impresses your customers most about AIXTRON machines for III-nitrides?

A: I believe that our customers' experts particularly like the mature reactor concept for the following reasons: it is a well-proven two-flow

Expansion at AIXTRON's Headquarters in Aachen, Germany.

reactor with pure laminar horizontal flow, excellent uniformity with very high efficiency in process gas usage, ultimate performance with respect to interface abruptness and fast heating/cooling capability required to make nitride-based LEDs and lasers.

It also includes a proprietary *in-situ* cleaning feature which offers superior maintenance. It is available for operation above 1200°C, with optional extension to 1600°C for the growth of SiC, for the manufacturing of nitride-based lasers on SiC buffer layers.

Q: I understand that you are collaborating with others on the nitride-based III-V material applications?

A: Yes, we have an impressive group of partners – universities, government R&D labs and so on plus leading commercial customers from industry. As you know we now have what we call "Centres of AIXcellence" in place in all the key geographic locations and these all have very good collaborations with local researchers. This is a key element of our strategy in supporting our existing user groups and gaining the confidence of our new customers. A critical factor for each of our industrial customers is our ability to maintain and strengthen their leading market positions and to have a short time to market. As we have to give each customer the very best support, these collaborations are strictly confidential.

Q: So, in general, 1995 was a "Golden Year" for AIXTRON?

A: Yes, I agree – thanks to our many new customers – a lot of good planning, the right investment in people and resources, not a little hard work, the orders have continued to roll in from all corners of the world. In fact we have had the best business year in our 12 year history. Our 4Q95 sales bookings were over $10 million and our total revenues in 1995 were up 40% on 1994. We are particularly pleased that many large manufacturing companies such as Siemens, Hewlett-Packard, Philips, Thomson, Samsung, UEC and important Japanese companies who chose to sign contracts with us to scale up their manufacturing plants. To support the increased demand we have recently expanded our manufacturing facilities. Finally, may I take this opportunity to extend to each of them a hearty welcome to the Network of AIXcellence. Also thanks to the large number of repeat orders, which are equally important to us, as they demonstrate satisfaction with our equipment and our leadership in the technology.

As I said, the new "Service Centres" in Tokyo, Seoul, Taipeh, Beijing and Singapore, are providing responsive local service for the large increase in customers in these countries. All in all, 1995 was a very positive year for AIXTRON, reflected in the necessary expansion of the workforce and worldwide service network. With orders already above $25 million target, all the signs are that strong demand is set to continue for 1996. We are glad to be ready for the next quantum leap in the business.